White Paper Report

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Division	Digital Humanities
Program	Digging into Data
Grant Status	Awarded

HJ-50069-12 The IMPACT Mummy Radiologic Database

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Project Activities

This project involved the creation of a Mummy Radiologic Database, the review of large number of mummy CT scans by collaborators from various expertise, and in-person meeting to facilitate reading by consensus. Many of the findings have been published in the scholarly literature and more publications are planned (see below). The project involved a computerized database which was set up by the Canadian collaborators.

Accomplishments

1. Discovery of the extensive presence of atherosclerosis, the disease which causes heart attacks and strokes, in ancient people from numerous ancient cultures. This finding was surprising to many because heart disease is thought to be a condition of modern man and caused by modern risk factors. The finding has led many specialists to re-think the importance of certain cardiovascular risk factors.
2. Large number of publications in the scholarly literature (see below)
3. Remarkable collaboration among specialists from widely disparate disciplines.
4. Development of a reading-by-consensus approach through this multidisciplinary collaboration.
5. Testimony to Congress in the Congressional Record.

a. Audiences

Based on the response in numerous venues, the scientific / medical community, museum curators, anthropologists, and the general public all found the results of the project to be enlightening.

b. Evaluation

The investigators view the project as being an overwhelming success. The grant money provided an unusual opportunity for specialists in widely disparate disciplines to collaborate and the scholarly literature contribution afforded by this grant has been remarkable. The general public has shown intense interest and great appreciation of the research work (see below). In terms of weakness, the Canadian collaborators created their own radiologic PACS and viewing system. This took much longer to develop and worked less well than systems which are now currently available commercially. An

approach using a commercial host server plus commercially available DICOM reading software (OsiriX) would work better, assuming security and licensing agreement concerns can be effectively solved. The team did use contemporary commercial internet communications tools (Go-to-meeting, Dropbox) with great success, however..

c. **Continuation of the Project**

The team plans to issue a final report of the cardiovascular system review in several months. Other investigators have asked to conduct research using the IMPACT radiologic system which is indeed a very rich database. The collaboration and partnership between the participating specialists from multiple disciplines were greatly strengthened by the project and will be continued.

d. **Long Term Impact**

The primary discovery, that atherosclerosis was present and not hard to find in ancient people, has caused many to reconsider the relative importance of cardiovascular risk factors and to consider alternative risk factors. Thus, the project has implications regarding the understanding of health and disease in ancient cultures and modern cardiovascular investigations. The research team was awarded a pilot grant this year and is applying for larger grant investment to pursue the next logical steps in this line of research.

e. **Grant Products**

Please see below for the list of publications..

Appendices

Narrative. NEH Grant HJ-50069-12

The IMPACT Study was funded by a grant from the NEH beginning in 2011 as part of the Digging Into Data Challenge and in collaboration with Canadian collaborators. The project involved the accumulation and archiving of CT scans and x-rays of mummies. The US team (funded by the NEH) reviewed the images primarily focusing on signs of cardiovascular disease. After some initial delays related to the Canadian team solving

hardware and security issues for the computer image archiving, the research has progressed successfully. The US side of the research has generated over 20 published manuscripts and abstracts to date and the NEH was acknowledged as the funding source for these scholarly publications. The public interest in the research has been intense, especially after the March 2013 presentation at the American College of Cardiology Scientific Sessions with simultaneous publication in *The Lancet.* At that time the work was featured in most of the newspapers of the world and covered by almost all of the major television and radio news outlets. There was also considerable media coverage in August of 2014 after additional features of the work were featured in a special edition of *Global Heart*.

Another abstract has been accepted for presentation in March 2015. That presentation and the subsequent manuscript submission will detail the cumulative results of all of the mummies in the study. Also, this NEH grant funded a "Reading by Consensus" meeting, held in Phoenix in December 2013. The results of that meeting and the IMPACT Study collaboration will be detailed in 6 articles in a special edition planned for the *International Journal of Paleopathology*. Manuscripts for this special edition are currently in preparation.

The NEH grant facilitated the collaboration across disparate scholarly disciplines in a way which is uncommon, but which is necessary for this sort of innovative work. Cardiologist, radiologists, anthropologists, palepathologists, aging biologists, preservationists, Egyptologists and archeologists all participated in the collaboration. The study was submitted as testimony to Congress and published in the Congressional Record as evidence of the large and sometimes unexpected benefits from such public Grant funding.

IMPACT STUDY PUBLICATIONS FROM NEH Grant

Original Research:

1. Fritsch KO, Hamoud H, Allam AH, Grossmann A, Nur el-Din AH, Abd el-Maksoud G, Al-Tohamy Soliman M, Badr I, Sutherland JD, Sutherland ML, Akl M, Finch CE, Thomas GS, Wann LS, Thompson RC. The Orthopedic Diseases of Ancient Egypt: Findings on CT Scans of 52 Mummies. Anatomic Record 2014, in press.
2. Wann LS, Thomas GS. What Can Ancient Mummies Tell Us About Atherosclerosis? Trends in Cardiovascular Medicine. In press.
3. Thomas GS, Wann LW, Narula J. What we can learn about atherosclerosis from the study of ancient people and mummies. Global Heart, 2014;9(2);185-186.

4. Sutherland ML, Cox SL, Lombardi GP, Watson L, Vallodolid CM, Finch CE, Zink A, Frohlich B, Kaplan HS, Michalik DE, Miyamoto MI, Allam AH, Thompson RC, Wann LS, Narula J, Thomas, GS Sutherland JD. Funerary Artifacts, Social Status, and Atherosclerosis in Ancient Peruvian Mummy Bundles. Global Heart 2014:9(2), 219-228.
5. Miyamoto MI, Djabali K, Gordon LB. Atherosclerosis in Ancient Humans, Accelerated Aging Syndromes and Normal Aging: Is Lamin A Protein a Common Link? Global Heart 2014;9(2):211-218.
6. Thomas GS, Wann LS, Allam AH, Thompson RC, Michalik DE, Sutherland ML, Sutherland JD, Lombardi, GP, Watson L, Cox SL, Valladolid CM, Abd el-Maksou G, Soliman MAT, Badr I, Nur el-din AH, Clarke EM, Thomas IG, Miyamoto MI, Kaplan HS, Frohlich B, Narula J, Stewart AFR, Zink AR, Finch CE. Why did ancient people have atherosclerosis? From autopsies to computed tomography to potential causes. Global Heart 2014;9(2):229-237
7. Zink A, Wann LS, Thompson RC, Allam AH, Finch CE, Frohlich B, Kaplan HS, Lombardi GP, Sutherland LM, Sutherland JD, Watson L, Cox SL, Miyamoto MI, Stewart AFR, Krause J, Narula J, MD, Thomas GS. Genomic Correlates of Atherosclerosis in Ancient Humans. Global Heart 9 (2), 203-209.
8. Wann LS, Thompson RC, Allam AH, Finch CE, Zink A, Frohlich B, Kaplan HS, Lombardi GP, Sutherland ML, Sutherland JD, Watson L, Cox SL, Miyamoto MI, Stewart AFR, Krause J, Raffel T, Narula J, Thomas GS for the Horus Study Group. Atherosclerosis - a Longue Durée Approach. Global Heart 9 (2), 239-244.
9. Thompson RC, Allam AH, Zink A, Wann LS, Lombardi GP, Cox SL, Frohlich B, Sutherland ML, Sutherland JD, Frohlich TC, King SL, Miyamoto MI, Monge JM, Vallodolid CM, Nur el-din AH, Narula J, Finch CE, Thomas GS. CT Evidence of Atherosclerosis in the Mummified Remains of Humans from Around the World. Global Heart. 2014:9(2):187-196.
10. Allam AH, Mandour Ali MA, Wann LS, Thompson RC, Sutherland ML, Sutherland JD, Frohlich B, Michalik DE, Zink A, Lombardi GP, Watson L, Cox SL, Narula J, Miyamoto MI, Sallam SL, Finch CE, Thomas GS. Atherosclerosis in Ancient and Modern Egyptians: The Horus Study, Global Heart. 2014;9(2):197-202.
11. Clarke EM, Thompson RC, Allam AH, Wann LS, Lombardi, GP, Sutherland ML, Sutherland JD, Cox SL, Soliman MAT, Abd el-Maksou G, Badr I, Miyamoto MI, Frohlich B, Nur el-din AH, Stewart AFR, Narula J, Zink AR, Finch CE, Michalik DE, Thomas GS. Is atherosclerosis fundamental to human aging? Lessons from ancient mummies. J Cardiol 2014;63(5):329-3.
12. Thompson RC, Allam AH, Lombardi GP, Wann LS, Sutherland ML, Sutherland JD, Soliman MAT, Frohlich B, Mininberg DT, Monge JM, Vallodolid CM, Cox SL, Abd el-Maksoud G, Badr I, Miyamoto MI, Nur el-din AE, Narula J, Finch CE, Thomas GS. Atherosclerosis across 4000 years of human history: the Horus study of four ancient populations. Lancet. 2013;381;1211-22.

13. Abdelfattah A, Allam AH, Wann S, Thompson A, Adelmaksoub G, Badr I, Amer HA, Nurledin H, Finch C, Miyamoto MI, Sutherland ML, Sutherland JD, Thomas GS. Atherosclerotic cardiovascular disease in Egyptian women: 1570 BCE–2011 CE. Int J Cardiol 2013;167(2): 570–574.

Abstracts:

1. Thompson RC, Allam AH, Lombardi GP, Wann LS, Sutherland, Sutherland JD, Zink A, Al-Tohamy Soliman M, Frohlich B, Monge JM, Vallodolid CM, Cox S, Abd el-Maksoud G, Badr I, Miyamoto MI, Nu red-din A, Watson L, Michalik DE , King SI, NarulaJ, Finch C, Thomas GS. CT Evidence of Atherosclerosis in Ancient Mummies: The Horus Study of 220 Mummies from 5 Continents. Accepted, Scientific Sessions of The American Association of Physical Anthropology. St. Louis, March 2015
2. Allam A, Thompson RC, Wann LS, Sutherland ML, Sutherland J, Frohlich B, Miyamoto M, Sallam SL, Mandour Ali MA, Finch C, Thomas GS. Atherosclerosis In Ancient And Modern Egyptians: The HORUS Study. Accepted for presentation, ACC 2014. Published in J Am Coll Cardiol 2014.
3. Thompson RC, Lombardi GP, Abd el- Maksoud G, Cox SL, Badr I, Thomas IG, Finch CE, Thomas GS. CT Imaging of Ancient Mummies Shows that Atherosclerosis Predates Modern Cultures. The Gerontologist 2013:53(S1):400.
4. Thompson RC, Allam AH, Lombardi GP, Wann LS, Sutherland ML, Sutherland JD, Soliman MAT, Frohlich B, Mininberg DT, Monge JM, Vallodolid CM, Cox SL, Abd el-Maksoud G, Badr I, Miyamoto MI, Nur el-din AE, Narula J, E CE, Thomas GS. Atherosclerosis across 3800 years of Human History: The HORUS Study of 4 Ancient Populations. ACC 2013 Late Breaking Featured Research presentation.
5. Thomas GS. The HORUS Study – The hunt for atherosclerosis. Presented at the 7th World Congress on Mummy Studies, June 11-15, 2011, San Diego CA
6. Allam AH, Wann LS, Thompson RC, Nureldin A, Gomaa A, Badr I, Soliman MAT, Hany HAR, Sutherland ML, Thomas GS. Atherosclerosis was common in ancient humans: Results of the Horus study of ancient Egyptian mummies. Eur Heart J 2011:13 (Supplement A): A49.
7. Thompson RC, Allam AH, Wann LS, Nureldin AH, Adelmaksoub G, I. Badr I, Sutherland ML, Sutherland JD, Miyamoto MI, Thomas GS. The search for heart disease in ancient Egyptians: CT scan results in 52 mummies. Eur Heart J 2011:13 (Supplement A): A6.
8. Thomas GS, Allam AH, Thompson RC, Nureldin A, Abdel-maksoud G, Badr I, Soliman MAT, Amer HAR, Sutherland ML, Sutherland JD, Miyamoto MI, Wann LS. Atherosclerosis is common In ancient humans: Results of the Horus study of ancient Egyptian mummies. J Am Coll Cardiol 2011;57(15):E1416.

9. Wann LS, Thompson RC, Allam AH, Miyamoto MI, Badr I, Abdel-maksoud G, Nureldin A, Thomas JJ, Thomas GS. Atherosclerosis: Not just a disease of contemporary humans. Circulation 2009;120:S354.
10. Thompson RC, Allam A, Wann LS, Miyamoto MI, Abdelmaksoud G, Badr I, Clarke KA, Amer HAR, Nureldin A, Hawas Z, Thomas GS. The Use of CT Scanning to Explore the Presence and Extent of Atherosclerosis in Ancient Egyptians: The HORUS Study. Journal of Cardiovascular Computed Tomography, Vol 3, No 4S:S28 July/Aug 2009.

Letters to the Editor:

11. Thompson RC, Allam AH, Wann LS, Finch CE, Thomas GS. Atherosclerosis in ancient populations -- Authors reply. Lancet 2013:382. No. 9887 pp 123-124.

Selected news coverage of 2013 Lancet article and others

1. New York Times, “CT Scans Find Vascular Disease in Ancient Mummies” by Nicholas Bakalar, March 10, 2013.
2. Wall Street Journal, “Telltale Finding on Heart Disease” by Ron Winslow. Wall Street Journal, March 10, 2013.
3. Pringle, H. “Long Live the Humans.” Scientific American. Oct 2013, pp. 48-55.
4. Coverage worldwide including NPR, BBC, Times of London, CBS, NBC, ABC, CNN, Nature, National Geographic, USA Today, Washington Post, LA Times, The Atlantic, New Scientist, Huffington Post.